régions hépatiques, dans le prolongement des grandes antennes, trois fortes épines plus développées encore chez l'adulte, et, à quelque distance en arrière, trois épines branchiales antérieures qui semblent faire défaut à ce dernier. Les grandes pointes marginales des épimères abdominaux ressemblent beaucoup à celles de l'adulte, mais les petites n'existent pas encore, les épines de la nageoire caudale sont moins nombreuses; toutes les autres, si abondantes chez l'adulte, font complètement défaut. D'ailleurs, les téguments sont coriaces et sans calcification aucune, l'abdomen est dépourvu des sillons transverses qu'on observe chez l'adulte, les pléopodes natatoires s'accouplent au moyen de crochets rétinaculaires, et les sternites thoraciques se prolongent en une pointe à la base des pattes, surtout à la base des pattes postérieures.

Ainsi, le petit animal ressemble déjà quelque peu à une Langouste, mais il s'en distingue par de nombreux caractères. On peut être assuré d'ailleurs qu'il passe directement à la forme définitive, car les très jeunes Langoustes sont à peu près de même taille.

On sait que la Langouste commune se range parmi les Palinuridés brévicornes (antennes internes à fouets courts); il en est de même de notre puerulus qui, par là même, ressemble aux puerulus de la Langouste du Cap (*Jasus lalandei*), de la Langouste néo-zélandaise (*Jasus verreauxi*) et d'une espèce caraïbe, le *Palinurus longimanus*. Il se rapproche surtout du puerulus de cette dernière espèce, car il présente comme lui des pointes sternales et, comme lui également, un exopodite flagellé sur les maxillipèdes externes. Les pointes sternales et le fouet des maxillipèdes font totalement défaut dans les autres puerulus brévicornes.

Nous voici donc, pour la première fois, *complètement renseignés sur le développement post-embryonnaire d'une espèce de Langouste*, et précisément sur celui qui nous intéresse le plus, le développement de notre Langouste commune: j'en possède tous les stades, depuis l'œuf jusqu'à l'adulte, et notamment le puerulus resté jusqu'ici inconnu. Que devient ce puerulus? Il est, on le sait maintenant, d'abord pélagique à la manière des phyllosomes, mais il doit gagner très vite le fond où il se cache et où une mue lui fait acquérir la forme des Langoustes.

Les résultats précédents semblent avoir quelque importance, car ils donnent la solution définitive d'un problème qui occupait les zoologistes depuis près d'un siècle. Je dois en rendre grâces au personnel si aimablement dévoué du Laboratoire de Plymouth, surtout au Directeur, M. Allen, qui fit multiplier pour moi les pêches pélagiques, et à M. Clark, Assistant, qui s'est emplové à rendre les occupations fructueuses et, aidé de M. Gossen, a recueilli le premier exemplaire de puerulus. J'adresse à tous mes vifs remercîments, —et à vous aussi, Monsieur le Directeur, si, comme je me plais à le croire, vous voulez bien donner l'hospitalité de votre journal anglais à un travail effectué par un Français dans les eaux anglaises.

E. L. BOUVIER,
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The Laboratory, Citadel Hill, Plymouth,
8 Août.

The Origin of Actinium.

THE question of the origin of actinium is one of very great interest at the present time. The law governing the position of the radio-elements in the periodic table led A. S. Russell, K. Fajans, and myself independently to predict the existence of a new member of the uranium series, the direct product of uranium-X, occupying the vacant place in the periodic table in the VA family, the heaviest known representative of which is tantalum. I suggested that if this "eka-tantalum" disintegrated dually, as in the case of the C-members occupying the place in the VB family, one mode with the expulsion of a β and the other with the expulsion of an α ray, the product of the first mode would be uranium-II., and of the second actinium. This could only have remained undetected if eka-tantalum had a very long period. The suggestion was disproved almost at once by the discovery of the missing element by Fajans and Beer, which has since been confirmed by Hahn and Meitner, and also by Fleck in this laboratory. It turns out to be a very short-lived member with a period of average life of about 1·7 minutes, and gives β rays only, the hard β rays before ascribed to uranium-X, which itself gives only soft β rays.

The obvious alternative was that actinium must be produced from radium in a β-ray change, that is that the first change of radium must be dual, the well-known α-ray change into emanation taking place simultaneously with a β-ray change into actinium. This suggestion receives some support from the fact that radium, as found by Hahn and Meitner, does give, in addition to α rays, a very soft β radiation.

But some experiments, of which I now wish to give a preliminary account, seem also to disprove this alternative. A specimen of Giesel's original radium bromide, now ten years old, containing 13·2 mgs. of radium (element) on the international standard, has been examined for actinium, and not the least trace could be detected. During the whole time since it was purchased, it had not previously been removed from its original ebonite capsule or subjected to any treatment. It was found to consist for the most part of insoluble sulphate, due to its action, no doubt, upon the sulphur in the ebonite capsule. It was brought into complete solution as chloride, radium-D, -E, and -F removed with a trace of bismuth by hydrogen sulphide, and a trace of aluminium chloride added and removed with ammonia. The aluminium hydroxide was repeatedly dissolved in acid and reprecipitated with ammonia until free from radium. The actinium and radio-actinium would remain with the aluminium, the actinium-X being completely removed with the radium from which it is non-separable. Tests for the active deposit were carried out in a stream of air, designed to replace the air in the box containing the preparation once every 5·6 seconds, the period of the actinium emanation. This was in order to suppress the effect of any radium relatively to that of the actinium, but it was not necessary, as neither radium nor actinium were present. On the other hand, a minute amount of the pure thorium active deposit was detected.

The α-ray effect obtained in the air stream mentioned with three hours' exposure, four days after preparation, when one-half of the equilibrium amount of thorium-X would be present, equalled that of about 0·15 mg. of uranium oxide, and was amply sufficient to characterise beyond all doubt. At first sight this result is surprising, but it is exactly what is to be expected if the chemical operations had been successful in their purpose. For there is thorium in Joachimsthal pitchblende, withal a very minute amount, and the corresponding mesothorium would be quantitatively removed with the radium, in the course of time to grow radiothorium. The detection of this infinitesimal trace of radiothorium by the active deposit test is a guarantee that if actinium had been formed it would have been detected, for radio-actinium and radiothorium are non-separable. An actinium active deposit, equivalent to less than 0·1 mg. of uranium in activity, could have been detected, and, taking into account the various corrections, it is reasonable to conclude that the full equili-

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orium amount cannot certainly be greater than that equivalent in α activity to 2 mg. of uranium. At present the preparation has reached about one-fourth of its equilibrium value as regards actinium-X.

In ten years, of the 13·2 mg. of radium in the preparation, 0·053 mg. would have disintegrated. On the assumption that uranium is the primary parent of actinium, Rutherford has calculated that 8 per cent. of the atoms disintegrating must choose the actinium route ("Radioactive Substances," p. 523). So that, if it were formed from radium, the amount of actinium present in the preparation would be 0·0042 mg. But the active deposit from this quantity has an α activity not greater than 2 mg. of uranium. Hence the period of average life of actinium must be at least fifteen million years, the quantity in minerals must be at least 170 grams per ton of uranium, and the α activity of pure actinium in equilibrium could not be greater than 1650 times that of uranium. But a specimen of actinium, prepared and presented to me by Dr. Giesel, must have, judging from a cursory examination, a far greater activity than this, and Mme. Curie ("Radio-activité," I., p. 189) speaks of some actinium preparations as of the order of 100,000 times as active as uranium. All the researches go to show that its actual quantity in minerals is very small, and, if there were anything like 500 times as much actinium as radium in minerals, one would have expected it long ago to have been isolated and its spectrum and chemical reactions characterised. So that the experiments appear to disprove the possibility that actinium can be formed directly from radium. Similar arguments to those above may be used to show that it cannot be a primary radio-element, and its origin remains still a mystery. In the current number of the *Physikalische Zeitschrift* (p. 752) Hahn and Meitner modify my original suggestion and suppose that the branching of the uranium series takes place at uranium-X, two simultaneous β-ray changes occurring, which produce two eka-tantalums, one the known short-lived β-ray-giving product, and the other a still unknown long-lived α-ray-giving parent of actinium, also in group VA. There seems nothing improbable about this. It is almost the only other alternative remaining to be tested, and it should not be difficult to settle by experiment.

FREDERICK SODDY.

Physical Chemistry Laboratory,
University of Glasgow, August 16.

Radium and the Evolution of the Earth's Crust.

HAVING been away from home, I did not see Mr. Holmes's letter on radium and the evolution of the earth's crust, contained in NATURE of June 19, until some weeks after its publication, and thought that the interest in the subject would have so far passed as to make it not worth while referring to, what I believe to be, a considerable misapprehension of the structure of the earth as revealed by earthquakes. Later correspondence has shown that interest in the subject has not waned, and as a correct appreciation of what has been established regarding the constitution of the interior of the earth seems likely to remove some of the difficulties which have arisen out of the study of radio-activity, it may be useful to review the results obtained from the study of the transmission of earthquake waves to long distances.

To begin with, it must be distinctly understood that this line of research can tell us nothing, directly, regarding the chemical composition of the earth, nor can we distinguish between stony and metallic material; all that can be established is the rate at which two distinct forms of wave motion are transmitted, and if, at any particular depth, we find a marked change in these rates of transmission, we may say that it is caused by a change, either in chemical composition or physical state, of the material through which the waves have travelled. With this premised; the first great change takes place at, probably, about ten miles or so from the surface, and seems to correspond with the passage from the heterogeneous and fractured rocks of the outermost skin to more homogeneous material. Below this, and to a depth of about 100 miles, it is difficult to say whether any further change takes place; there are indications of change at about fifty and about one hundred miles, but it is not such as has a great effect on the rate of transmission of the simpler forms of elastic waves, and, as the differences in the time intervals concerned are not of a greater order of magnitude than the inevitable uncertainties of observation, it is difficult to be certain of the reality of the supposed alteration.

Below a depth of about 100 miles there is no evidence of any change until a depth of about 2400 miles is reached; throughout this layer there is a progressive increase of elasticity, but it is gradual and seems to be directly connected with the increase of pressure, with the result that the material, whatever it may be, develops a high degree not only of resistance to compression but also of rigidity as against stresses of short duration. At the depth mentioned, or at somewhere between 0·6 and 0·5 of the radius, measured from the surface, a very marked and remarkable change in the nature of the material, of which the earth is composed, takes place. The change is rapid, and is characterised by a small decrease in resistance to compression, accompanied by a great reduction, if not the complete disappearance, of rigidity. It is impossible to determine how this change is brought about, but it is very much what would be produced either by passage from the stony shell to the metallic core, of one hypothesis, or from the fluid or solid-fluid to the gaseous state, of another.

Whatever may be the final interpretation of the distant records of great earthquakes, the important point to be noticed is that the two great changes which they indicate in the constitution of the interior of the earth are, first, at a depth of only a few, probably not more than ten, miles, and, secondly, at about 2000 to 2400 miles from the surface. Between these depths there are suggestions of variations in composition down to a depth of 100 miles or thereabouts, but they seem to be of only minor importance, and apart from this no change in physical character, or, presumably, in chemical composition, can be detected.

R. D. OLDHAM.

8 North Street, Horsham, Sussex, August 15.

Poroscopy: the Scrutiny of Sweat-pores for Identification.

AT the recent meeting of the British Medical Association some attention was directed to a method of criminal identification which has been used at Lyons and elsewhere. A fully illustrated account of it occurs in *Les Archives d'Anthropologie criminelle* for July, from which, after careful perusal, I cannot find that there is anything in the method that does not come under the scope and practical working of dactylography. Dr. Locard has shown good reason why we should give more attention than has been usual to small patches of finger-prints, and to seek among the pores for what the ridges are too meagre to supply. Dr. James Scott, at Brighton, rightly describes "poroscopy" as founded on a study of the "impressions or orifices of the sweat ducts of the finger pulp, instead of the ridges." But pores, the openings of sweat ducts, as printed impressions, cannot be studied quite

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